Field Evaluation
Shinyei Technology -
PM Sensor Evaluation Kit

South Coast AQMD

AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Background

- From 02/05/2015 to 04/08/2015, three **Shinyei Technology - PM Sensor Evaluation Kit** units were deployed at one of our monitoring stations in Rubidoux, CA, and run side-by-side with two Federal Equivalent Method (FEM) instruments measuring the same pollutant

- PM Sensor Eval Kit (*3 units tested*):
  - Particle sensors (optical; non-FEM)
  - Each unit measures: $PM_{2.5}$ (ug/m^3)
    Unit cost: ~$1,000
  - Time resolution: 1-min
  - Units IDs: SHN #1, SHN #2, SHN #3

- MetOne BAM (*reference method*):
  - Beta-attenuation monitor (FEM)
  - Measures $PM2_{.5}$
  - Cost: ~$20,000
  - Time resolution: 1-hr

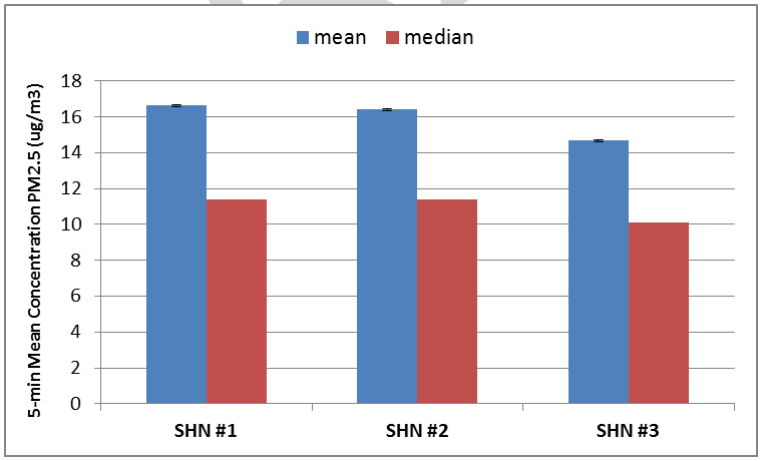
- GRIMM (*reference method*):
  - Optical particle counter (FEM)
  - Uses proprietary algorithms to calculate total PM, $PM_{2.5}$, and PM_1 from particle number measurements
  - Cost: ~$25,000 and up
  - Time resolution: 1-min

Data validation & recovery

- Basic QA/QC procedures were used to validate the collected data (i.e. obvious outliers, negative values and invalid data-points were eliminated from the data-set)
- Data recovery for $PM_{2.5}$ from all three units was >99%

Shinyei Sensors; intra-model variability

- Low measurement variations were observed between the three Shinyei devices tested



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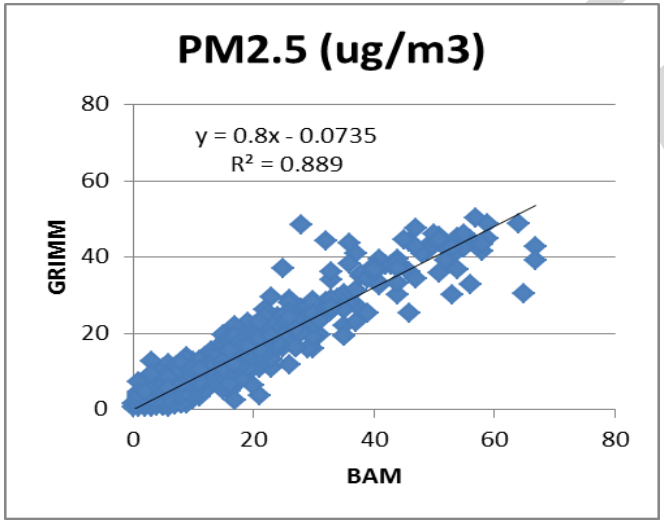
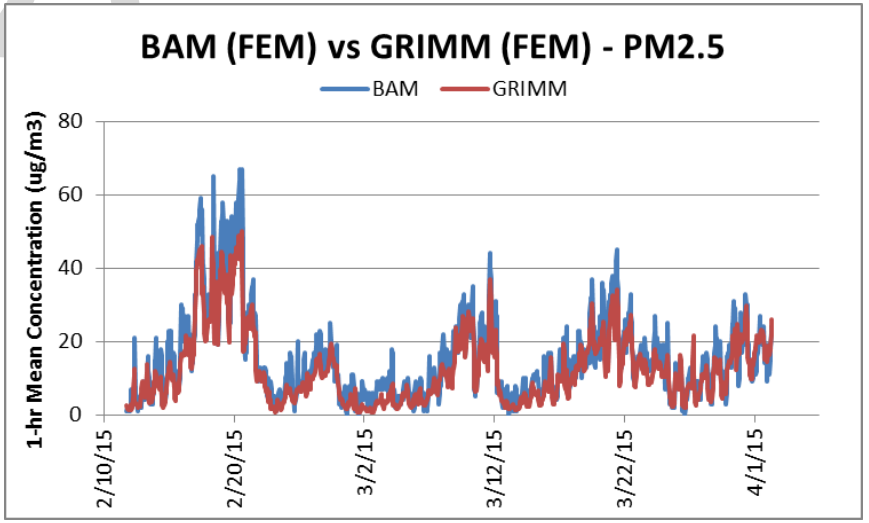
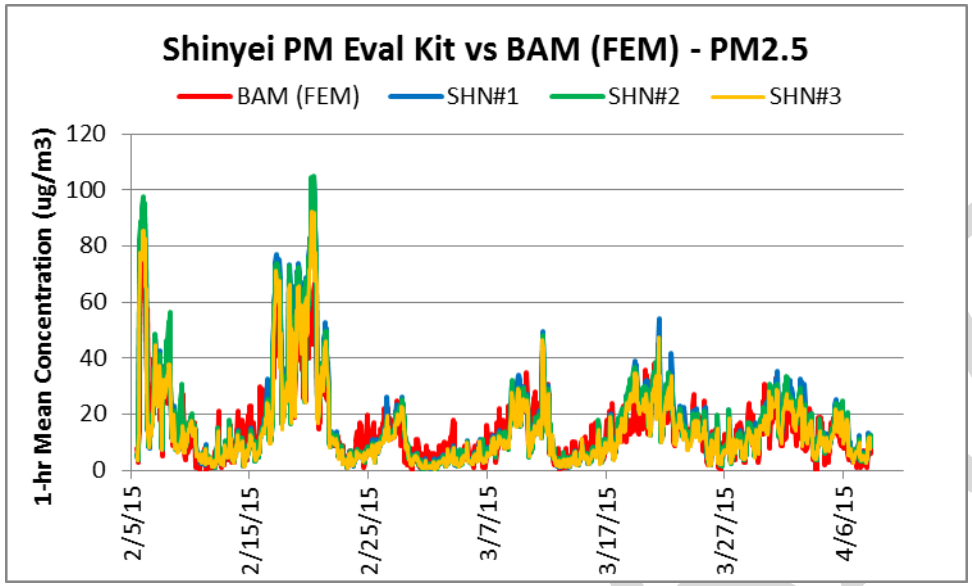
Equivalent Methods: BAM vs GRIMM

- Very good correlation between the two equivalent methods

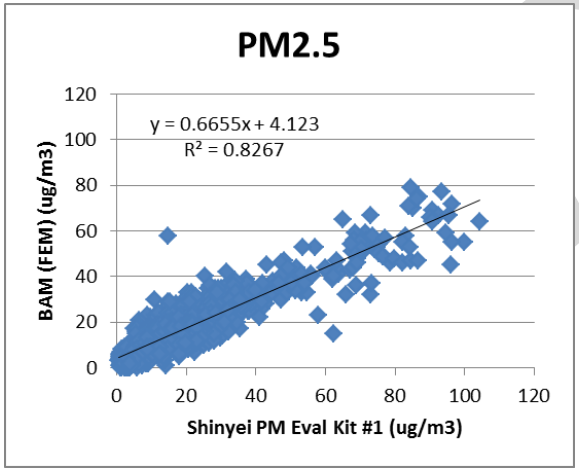


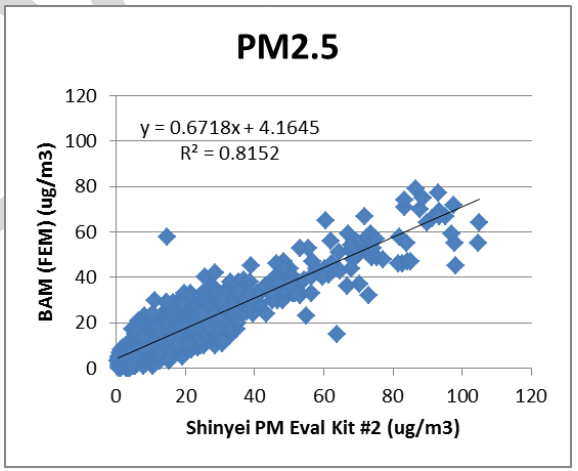


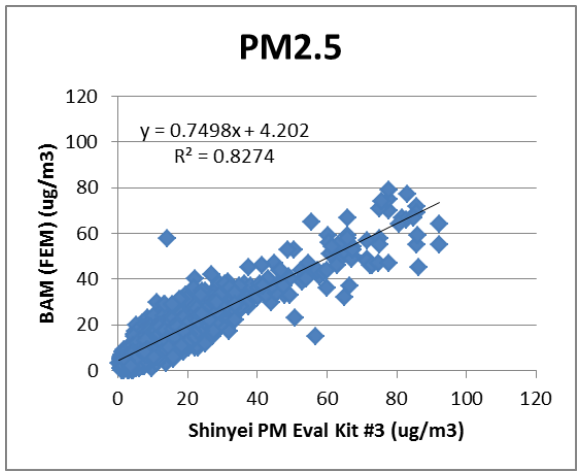
Shinyei PM Sensor Eval Kit vs FEM BAM ($PM_{2.5}$; 1-hr mean)



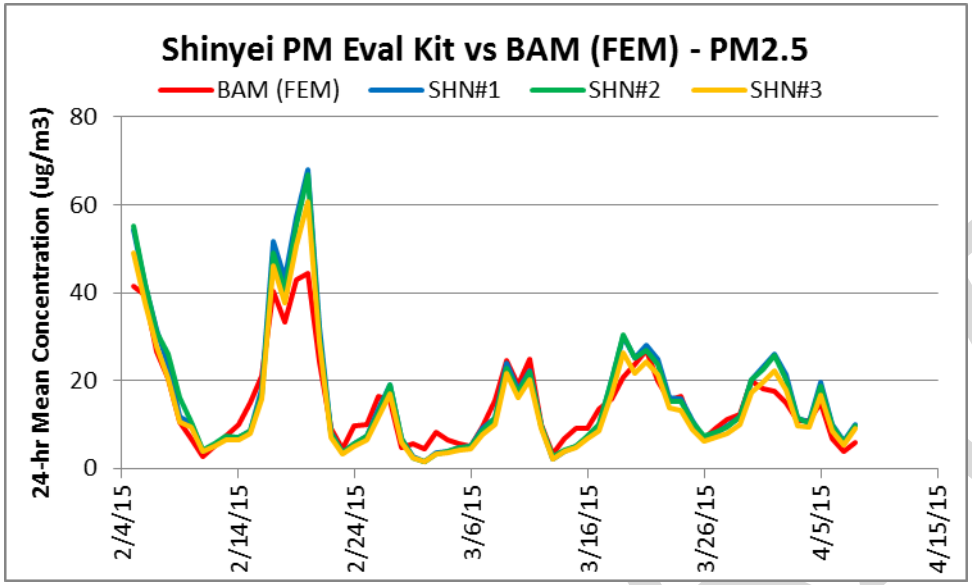
- All $PM_{2.5}$ measurements correlate well with the corresponding FEM BAM data (R^2>0.81)



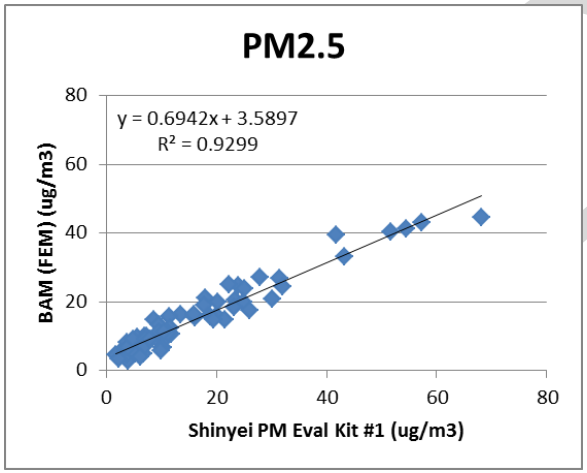


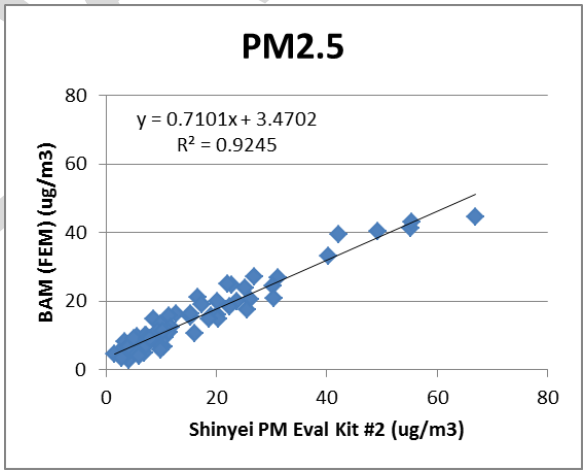


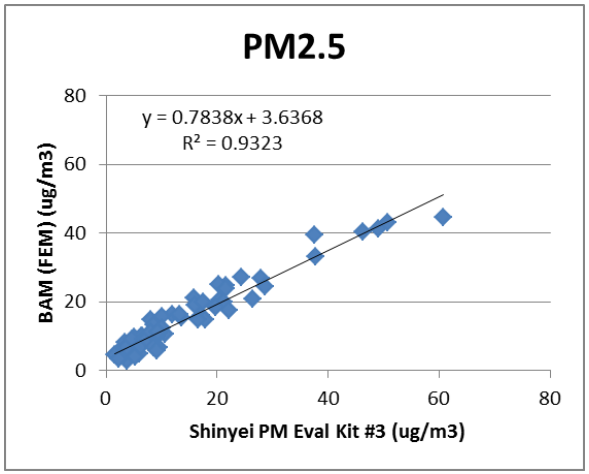
Shinyei PM Sensor Eval Kit vs FEM BAM ($PM_{2.5}$; 24-hr mean)



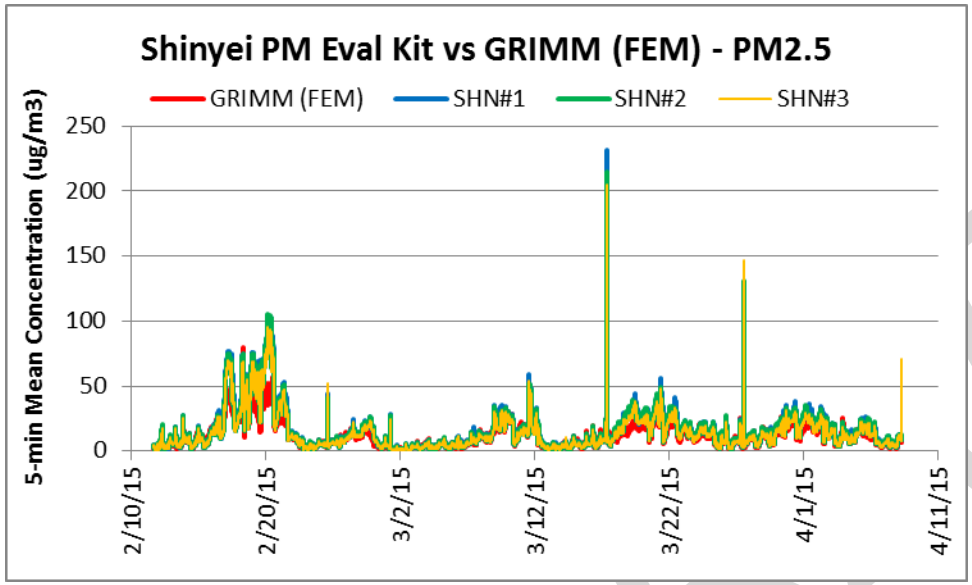
- All $PM_{2.5}$ measurements correlate very well with the corresponding FEM BAM data (R^2>0.92)



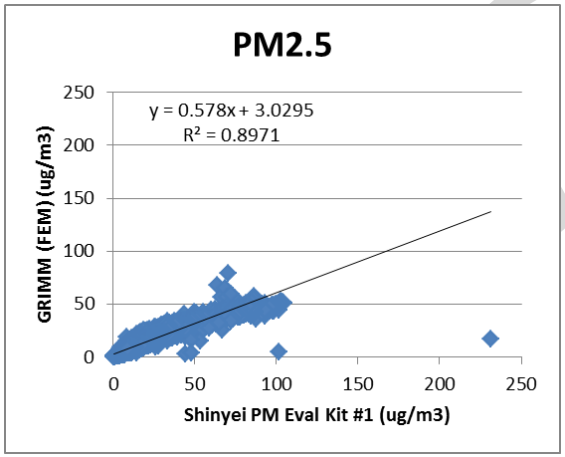


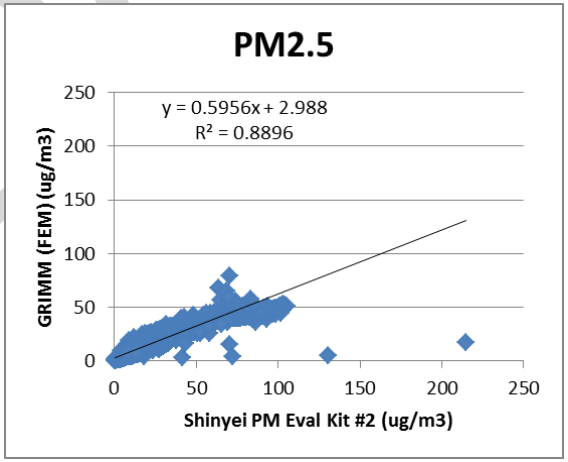


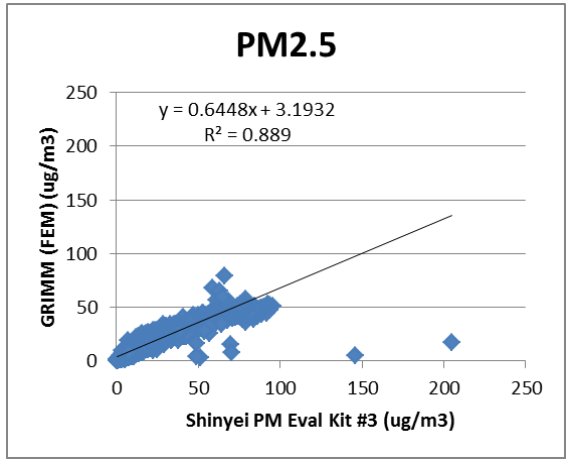
Shinyei PM Sensor Eval Kit vs FEM GRIMM ($PM_{2.5}$; 5-min mean)



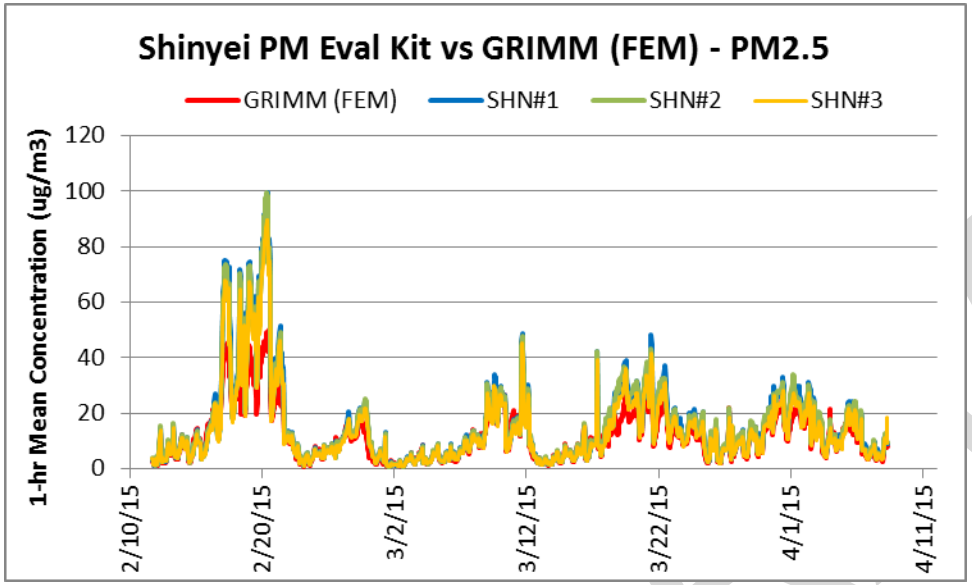
- All $PM_{2.5}$ measurements correlate very well with the corresponding FEM GRIMM data (R^2>0.88)



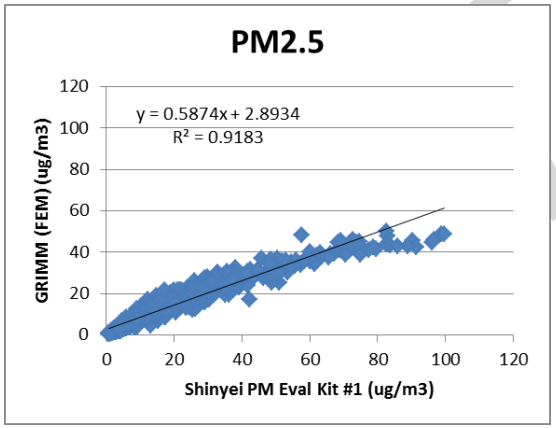


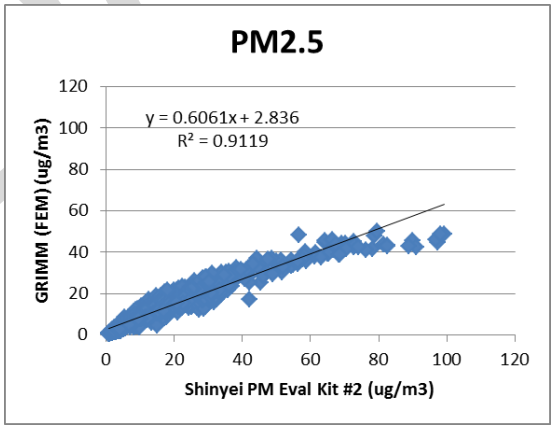


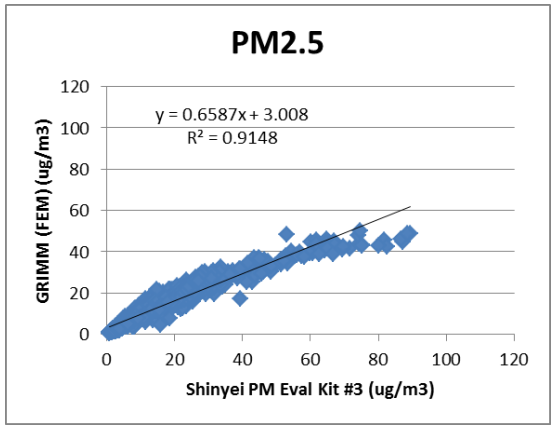
Shinyei PM Sensor Eval Kit vs FEM GRIMM ($PM_{2.5}$; 1-hr mean)



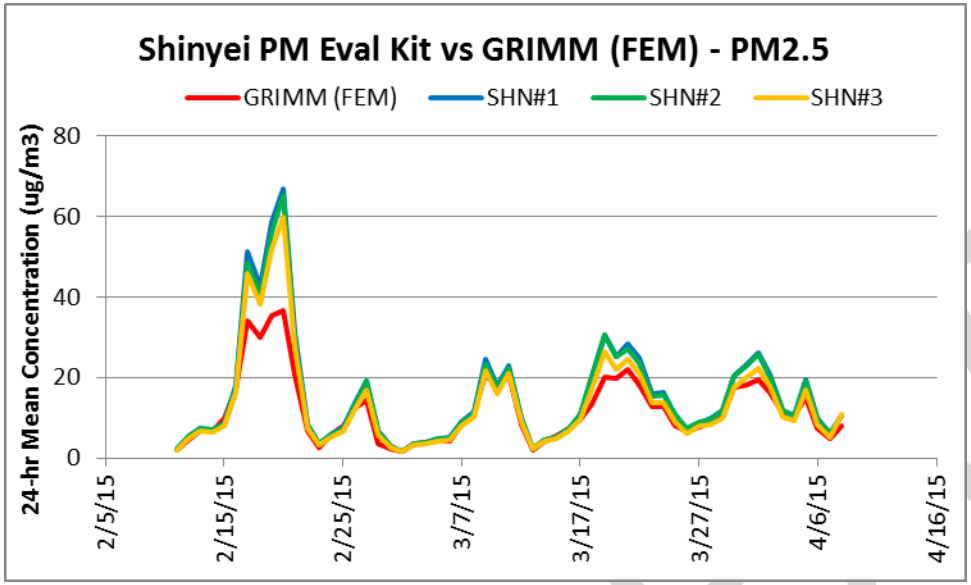
- All $PM_{2.5}$ measurements correlate very well with the corresponding FEM GRIMM data (R^2>0.91)



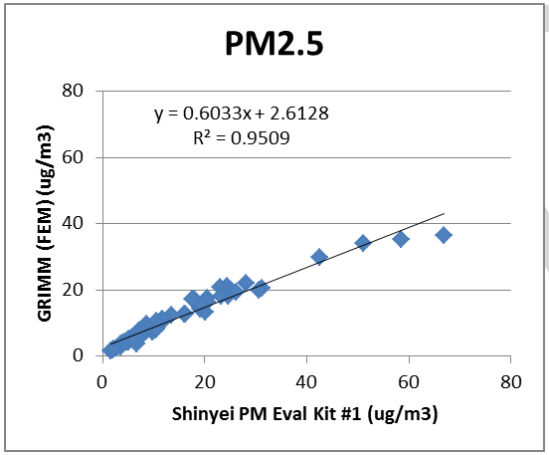


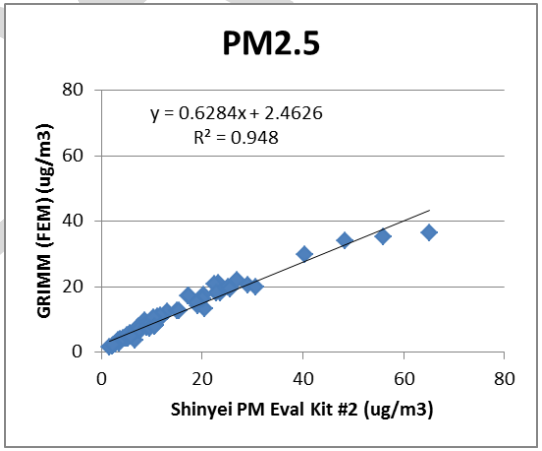


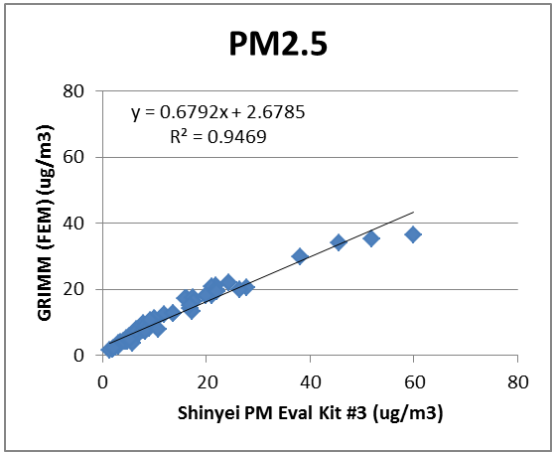
Shinyei PM Sensor Eval Kit vs FEM GRIMM ($PM_{2.5}$; 24-hr mean)



- All $PM_{2.5}$ measurements correlate very well with the corresponding FEM GRIMM data (R2>0.94)







Discussion

- Overall, the three Shinyei Sensors performed very well and showed:
  - No down time over a period of about two months
  - Low intra-model variability
  - Good correlation to substantially more expensive FEM instruments (BAM and GRIMM)
- Shinyei data was usually overestimated, although no sensor calibration was performed prior to the beginning of this field testing
- Laboratory chamber testing is necessary to fully evaluate the performance of these sensors over different / more extreme environmental conditions

- All results are preliminary